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Predicting Postpartum Depression among Adolescent Mothers: A Systematic Review of Risk

Author Listing: Rebecca Hymas¹ & Lisa-Christine Girard, PhD¹

Affiliation: 1) School of Health in Social Science, Clinical Psychology, University of Edinburgh

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Introduction

Despite a steady decline in conception rates over recent decades, adolescent pregnancy has remained stable and is of international concern (Treffers, 2003; Wellings et al., 2016). Pregnant and parenting adolescents have been shown to be at increased risk for adverse physical and mental health outcomes as compared to their adult counterparts, including medical complications for both mother and child, having an infant with lower birth weight, and increased likelihood of infant mortality (Jaffee et al., 2001; Hodgkinson et al., 2014). Moreover, adolescent mothers appear to be at increased risk of postpartum depression (PPD) (Mollborn & Morningstar, 2009). Rates of PPD among mothers of all ages in western societies are reported to range from 13%-19% (O'Hara and McCabe, 2013), yet estimates are much higher, up to approximately 40%, in adolescent mothers

(Easterbrooks, Kotake, Raskin, & Bumgarner, 2016; Logsdon et al., 2005; Schmidt et al., 2006).

However, the finding of increased prevalence of PPD compared with nulliparous adolescents is inconsistent in the literature (Troutman and Cutrona, 1990; Hipwell et al., 2016a). There are many reported detrimental effects of PPD, although this is predominantly evidenced from adult populations. PPD may contribute to emotional, behavioural and interpersonal problems for the mother, which are likely to negatively affect her interaction with, and provision of care for, her baby (Hill et al., 2013). For example, PPD has been associated with parental unresponsiveness, and negative child perceptions (Gelfand and Teti, 1990), a less-secure infant attachment style (Toth et al., 2009), and increased likelihood of child psychopathology (O'Donnell et al., 2014). Caregiving activities, such as breastfeeding, sleeping and feeding routines have also been found to be compromised by PPD (Hill et al., 2013). PPD has also been shown to negatively impact on the long-term emotional and behavioural functioning of offspring later into childhood (Giallo et al., 2015) and even adolescence (Sanger et al., 2015), yet such consequences are not inevitable (Lawlor and Shaw, 2002). Additionally, PPD may be a precursor of chronic recurrent depression in mothers (Wisner et al., 2002).

There is currently however, a lack of consensus when defining PPD (Wisner et al., 2010), and identification and diagnoses can be hindered by difficulty in distinguishing less severe depressive symptoms from the supposed “normal” course of childbearing (Hall & Wittkowski, 2006). Notably, some researchers even refute that depression following childbirth differs significantly from depressive illnesses occurring at other times in the lifespan (Evans et al., 2001). The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM 5; APA, 2013) and the International Classification of Diseases (ICD-10; WHO, 2004) add complexity to this division in the field given that they do not recognise postpartum depression as a separate diagnosis. Instead, it is defined as a Major Depressive Episode with an onset specifier within pregnancy or four weeks postpartum, and as a postpartum mood disturbance during the puerperium (six weeks postpartum), respectively. However, in practice, PPD has been reported to have an onset up to 12 months postpartum (Gaynes et al., 2005). Within this review, PPD is defined as moderate to severe depression experienced during the first year postpartum, with symptoms persisting for more than two weeks following delivery (Beck & Gable, 2001).

Comparing Adult and Adolescent PPD

Although adolescent mothers are likely to suffer similarly adverse effects of PPD, research suggests that adolescents may experience PPD differently to adults. For example, in comparison to adult mothers, depressive symptoms have been shown to persist in adolescent mothers for longer durations after delivery (Schmidt et al., 2006), and confer an increased likelihood of rapid subsequent pregnancy (Barnet et al., 2008), as well as a higher risk of intimate partner violence than adult mothers (Lindhorst and Oxford, 2008).

As a result of such disparities in PPD prevalence and outcomes between adolescent and adult mothers, research has examined mechanisms underlying these differences. Proposed mechanisms for these differences have included adolescent mothers having unmet idealistic expectations of motherhood (Lesser et al., 1998; Connolly et al., 2012); more negative evaluations of their body changes during pregnancy (Carter et al., 2000); feelings of inadequacy about the

maternal role (Uzun et al., 2013) and experiencing conflict between wanting more autonomy as a developing adolescent, yet requiring more support as a new mother (Logsdon et al., 2005). Higher prevalence of social isolation and higher levels of parenting stress in adolescent mothers have also been suggested (Torres et al., 2017).

While research suggests that adolescent and adult mothers may experience PPD differentially, direct comparisons between groups creates challenges within research aiming to identify prevalence rates and risk factors specific to the adolescent population. For example, age is a known confounder with other variables associated with depressive symptoms such as socio-economic status (SES), marital status, educational level, and social support (Bradshaw et al., 2014). Additionally, risk factors for adolescent PPD may be confounded by those that predispose someone to adolescent pregnancy, presenting a potential barrier to the accurate identification of risk factors specific to adolescents. Therefore, within this particular context, it may be more informative to examine differences between depressed and non-depressed childbearing and nulliparous adolescents. This would also control for the developmentally-normative increase in depression expected across adolescence (Balázs et al., 2013).

Current Limitations for Identifying Risk Factors Specific to Adolescent PPD

Studies attempting to identify risk factors for adolescent PPD have been limited by their inability to establish precedence of predictors. Such discrepancies challenge the ability of researchers and clinicians to communicate, diagnose, and treat adolescents who suffer from PPD. Thus, risk factor terminology used in this review is analogous to those outlined by Kraemer and colleagues (1997). While there is a paucity of research exploring the unique factors implicated in adolescent PPD, there are currently five published reviews summarising between 9 and 40 studies of 'risk factors' associated with adolescent peripartum depression. The culmination of these reviews has suggested associations between several psychosocial variables and increased PPD symptoms, which include family conflict (Reid & Meadows-Oliver, 2007), interpersonal factors, perceived parental competence, coping (Kleiber and Dimidjian, 2014), maternal childhood

experiences, body satisfaction (Siegel & Brandon, 2014), substance use and trauma history (Dinwiddie et al., 2017), prior depression, and a history of abuse (Recto & Champion, 2017). Social support, self-esteem, and stress were also found to be associated with increased PPD symptoms across several reviews.

Despite identification of these suggested risk factors for adolescent PPD, a major limitation consistent across all reviews is the inclusion of at least one study with participants enrolled in, or recruited from, an intervention/programme directed at improving outcomes for adolescent parents. This may have directly or indirectly impacted upon the results of studies included in these reviews. For example, involvement in an intervention/programme may have perceived impacts upon risk factors implicated in PPD (e.g., perceived social support), or PPD itself, creating challenges with any generalisations made to the larger population. Furthermore, selection effects into the intervention/programme may be present. Another limitation of the aforementioned reviews is the potential of publication bias in not having included unpublished literature in their reviews (Reid & Meadows-Oliver, 2007; Dinwiddie et al., 2017). The inclusion of participants up to the age of 21, an age-range which has been cited in the literature as 'young adults' (Milan et al., 2007), may also affect the generalisability of conclusions to 'adolescent' populations exclusively (Recto & Champion, 2017; Siegel & Brandon, 2014). Another common limitation across all previous reviews was the inclusion of studies which used concurrent assessments of 'risk factors' and depressive symptoms, thus preventing the ability to infer predictive paths (Foster, 2010). Finally, despite all reviews including studies of varying quality, only one (Recto & Champion, 2017) mentioned conducting a quality assessment and none of them reported on the potential implications of this. Taken together, these limitations may reduce the applicability of the conclusions drawn from these reviews.

Objectives

Given the potentially increased vulnerability of developing PPD in adolescence, coupled with the adverse impacts of PPD for both adolescent mothers and their infants, a better understanding of potentially implicated risk factors is of paramount importance. This may help in

advancing our theoretical knowledge, to guide the development of effective prevention programming (Murray et al., 2009). Thus, this review will first aim to address the current knowledge gap regarding antecedent risk factors associated with PPD, specifically in adolescence. A rigorous review and quality appraisal of the current adolescent PPD risk factor literature will also be important in helping to inform the evidence base, as well as influencing future practice and policy. Thus, the second aim of the review is to assess the current quality of the evidence base. Paediatric nurses and school-based clinicians are uniquely placed to engage with vulnerable adolescents at risk of becoming pregnant, and whom may subsequently develop PPD. With improved knowledge of the current evidence for adolescent PPD risk factors, clinicians may be able to identify PPD at an earlier stage in development, through efficient and accurate screening and clinical assessment. Implications for future research in this area will also be discussed.

Methodology

Protocol

A protocol outlining the inclusion criteria and methods of analysis was specified in advance of undertaking this review. It was accepted for registration on PROSPERO on 01/11/2017 (Protocol number: CRD42017077172). For transparency, this systematic review was undertaken following PRISMA guidelines (Liberati et al., 2009).

Eligibility Criteria

Inclusion criteria were as follows: studies using observational designs; with a previously validated measure of depression; with onset of illness defined as within 12 months of childbirth, but which had persisted past two weeks postpartum; adolescent mothers less than 20 years of age; and which included risk factor(s) that occurred *prior* to the postpartum period. If a study included a larger age range, the study was included if subgroup analyses had been conducted on adolescents. Exclusion criteria included: studies from undeveloped or developing countries (due to the expected differential perception, recognition and assessment of PPD; Halbreich & Karkun, 2006); having only a measure of prenatal depression; measuring risk factors during the

postpartum period only (unless they included retrospective report); experimental designs whereby participants were enrolled in any intervention/programming efforts, regardless of whether it was aimed at PPD. Qualitative studies, case-study and case-series designs were also excluded from this review.

Information Sources

The following electronic databases were searched for published literature: PsycINFO (1806Present); EMBASE (1947-Present); MEDLINE (Ovid MEDLINE(R) Epub Ahead of Print, In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) 1946-Present); ASSIA; CINAHL(Complete); MIDIRS. Published literature was also examined through searching of reference lists of relevant articles or reviews and hand-searching of relevant journals (e.g., *Maternal and Child Health*, *Journal of Midwifery & Women's Health*, and *Birth: Issues in Perinatal Care*). Unpublished literature was searched in the ProQuest Dissertations & Theses Global database. Articles were restricted to those published since 1992, as Major Depressive Disorder with postpartum-onset was not recognised in the ICD-10 until 1992, and likewise in the DSM-IV until 1994.

Search and Selection

Key search terms were employed in each database using a five-component strategy to identify risk factors, the postpartum period, depression, adolescents, and mothers (e.g., 'risk factor', 'determinant', 'postpartum', 'depress*', 'adolescen*', 'teen', 'mother'). Please see the online supplement for the comprehensive electronic search terms used and strategy employed within the Ovid Platform. The search was completed on 2nd April 2018. The search initially returned 1,656 articles, reducing to 1,343 following deduplication. The PRISMA flow diagram summarises the study selection processes (See Figure 1). All study titles and abstracts (i.e., 100%) were screened for relevance, independently by both the first and second author, and full copies of all manuscripts likely to meet selection criteria were obtained and reviewed by the first author. The second author randomly reviewed 20% of the full text articles returned from the electronic search strategy for inclusion eligibility at this stage, using a random sequence generator software. Interrater

agreement was 91% prior to discussion and consensus. Full-text review excluded 124 articles due to articles meeting at least one exclusion criteria (i.e., being conducted in undeveloped countries, samples of females ≥ 20 years of age, not specifying risk factors measured prior to birth, measuring depression after 12 months postpartum, or studies that included an intervention). Of the remaining studies meeting all inclusion criteria, six were deemed to include overlapping study samples, thus resulting in 11 cohorts from 14 studies that were eligible for quality appraisal.

Quality Assessment

The quality and risk of bias for each included study was determined through two quality appraisal tools adapted for use in this review; the Effective Public Health Practice Project (EPHPP) Quality Assessment Tool for Quantitative Studies (Thomas et al., 2004), and the Cambridge Quality Checklists (CQC) for Systematic reviews of Risk Factors (Murray et al., 2009). The EPHPP quality appraisal tool is a six-component instrument which measures potential methodological bias (Armijo-Olivo et al., 2012). The EPHPP has demonstrated adequate content and construct validity (demonstrated through 53%-92% agreement in component ratings when compared to another highly rated instrument; Thomas et al., 2004), fair inter-rater agreement (Cohen's kappa value of 0.60) for individual domains, and excellent agreement (Intra-class correlation coefficient = 0.77) for the final rating (Armijo-Olivo et al., 2012). This tool was chosen as it contained the essential criteria for study quality appraisal as recommended by the Centre for Reviews and Dissemination (CRD; 2009). Furthermore, it aligns with the recommendations of the reporting of observational studies in epidemiology (STROBE; Vandembroucke et al., 2007), according to which, the studies within this systematic review adhere to.

For this review an additional 'Not Applicable' category was added to the EPHPP checklist, as some criteria were not appropriate for all included studies. In addition, given that longitudinal prospective data are optimal within this research context, we gave studies of such designs a rating of 'strong' for the Study Design category. The 3-item Risk Factor checklist from the CQC was also included to allow for an appraisal of the timing of the measurement/reporting of risk factors and PPD. The checklist was aligned with the EPHPP quality appraisal tool by reverse-scoring the

categories (i.e., a category of 'Strong' for designs specifying prospective data or inclusion of only fixed risk factors – (those necessarily preceding the outcome); 'Moderate' for retrospective data; and 'Weak' for cross-sectional data). Overall, studies were rated across the following: selection bias (i.e., how likely the selected participants represented the target population, and the percentage that agreed to participate), study design, control of confounders, data collection methods (i.e., whether the data collection tools were shown to be validated and reliable, previously as well as within the study), recording of withdrawal and dropout rates, and timing of risk factor measurement. Please see full reference (Thomas et al., 2004) for the link to the downloadable tool and dictionary. Criteria were rated as: Strong, Moderate, Weak or Not Applicable. The overall quality of the studies received a 'Strong' rating if no weak ratings were reported, 'Moderate' if one weak rating was reported, and 'Weak' if two or more weak ratings were reported.

The included studies were reviewed by the first author, with a subset (64%) reviewed by a second independent reviewer. Agreement in domain ratings and overall study quality was evaluated using the Cohen Kappa Statistic (Schuck, 2004). Any disagreements were then resolved through consensus after discussion. The Byrt (1996) criteria were used to interpret the kappa values as follows: excellent agreement represented by values between 0.93 – 1.00; very good between 0.81 – 0.92; good between 0.61-0.80; fair between 0.41-0.60; slight agreement between 0.21-0.40; poor between 0.01-0.20; and no agreement less than 0.01. Inter-rater reliability before consensus was as follows: good agreement for global ratings (77.78% agreement, weighted $k=0.67$, $SE=0.10$, $CI=0.46-0.87$), slight agreement for selection bias (44.45% agreement, weighted $k=0.22$, $SE=0.31$, $CI=0-0.816$) and good agreement for attrition (77.78%, weighted $k=0.74$, $SE=0.17$, $CI=0.41-1$). Kappa values could not be calculated for study design or data collection due to high (100%) agreement across studies between reviewers. Likewise, with the risk factor component rating, which achieved 88.89% agreement. Furthermore, a kappa value was not able to be calculated for the confounders component rating due to the non-applicability of this component in nine studies, however 66.67% agreement was achieved between reviewers.

Data Extraction

A data extraction tool was developed *a priori* (See Supplement Table 1 in the Online Supplement), as is recommended for systematic reviews (Boland et al., 2014). It was piloted on four randomly selected included studies and amended accordingly. Data was extracted by the first author electronically onto an excel spread sheet to minimise the risk of transcription errors. Information was extracted from each included study on: study characteristics (including authors, date, country, study design, and objectives), participant characteristics (including sample size, ages, and ethnicity), and study results (including risk factors measured, timing of data-collection, summary measures and reported significance values, primarily odds ratios for binary outcomes and Pearson's *r* or mean differences for continuous outcomes). Where studies did not report relevant effect sizes, these were calculated by the first author if appropriate statistics were available. To note, if a study reported associations between risk factors and depression at several time-points postpartum, only the follow-up data closest to one month postpartum were extracted, in line with the PPD diagnostic classification.

Across studies, some necessary statistical information was unavailable, and some data were not deemed appropriate for combining, as transformation may have resulted in only approximations in effect sizes (Bonett, 2007). Furthermore, estimates drawn from fewer than three studies in meta-analyses have been shown to be unstable and extreme approximations (Fox et al., 2015). Due to the small sample size, as well as the clinical and methodological heterogeneity of studies, risk factors were not comparable in this review, thus the results are synthesised narratively (Egger et al., 2001).

Results

Study Characteristics

The publication dates of studies ranged from 1992 – 2017. Seven of the 11 cohorts were conducted in the USA, one in Canada, one in Portugal, one in Sweden and one in Australia. Most studies were of longitudinal design, one was a retrospective cohort study (Nunes and Phipps, 2013), and one was a cross-sectional observational study (Logsdon et al., 2008). Seven studies

specifically focused on exploring risk factors (or cross-sectional associations) for adolescent PPD symptoms, one study explored PPD risk factors in the general maternal population, two studies examined changes in adolescent depressive symptomology across the peripartum, and the remaining four studies focused on the association of adolescent mother's depressive symptoms with parenting/caregiving variables. See Table 1.

Participant Characteristics

The participant sample sizes varied from 60 to 17,823 adolescents and ages ranged from 12 to 19 years. Five studies included comparison groups; four with adults (Figueiredo et al., 2007; Lanzi et al., 2009; Nunes and Phipps, 2013; Silverman et al., 2017) and one with non-childbearing adolescents (Hipwell et al., 2016a). All but two studies reported the ethnicity of the included sample.

The most represented ethnicities were Caucasian, African American, European American, Black, Hispanic and Métis. See Table 1.

Methodological Quality

Table 2 presents the quality ratings studies received. Most studies received an overall 'strong' rating, four studies were rated as 'weak' and two were rated as 'moderate'. Most studies were rated as having moderate selection bias and can be deemed as somewhat likely to represent the general target population. Only two studies were rated as having a 'weak' selection bias score, due to having less than 60% agreement of participation. All study designs apart from two (Logsdon et al., 2008; Nunes and Phipps, 2013) were denoted as 'strong' due to being of longitudinal design; the selection tool gave weak ratings to studies with undisclosed or cross-sectional designs. The confounders component rating was only relevant to five studies; four gained a score of 'weak', due to using an adult comparison group, and not controlling for baseline differences in participant characteristics, the other study received a 'strong' rating as it included an appropriate comparison group (i.e., non-childbearing adolescents).

Thirteen studies received a rating of 'strong' for the data collection component due to using and reporting validated and reliable outcome measures. However, this may be an over-estimation of quality, due to the focus of studies often not pertaining to PPD per se, but rather depression in general. One study (Nunes and Phipps, 2013) received a 'weak' rating due to using an amended outcome measure of depression symptoms with no reported validation or reliability. Studies received mixed scores for the attrition domain; the studies that received a weak rating were due to unreported attrition rates. The timing of risk factor measurement was strong for most studies, apart from those which measured risk factors only during the postpartum period. The study that received the most 'strong' ratings across all component ratings was Hipwell and colleagues (2016a).

Study Outcomes

The measurement of risk factors ranged from five years prior to childbirth to 10 months postpartum. Three studies measured risk factors retrospectively; one at four weeks postpartum (Leadbeater and Linares, 1992), one between four and six weeks postpartum (Logsdon et al., 2008), and one between three weeks and 10 months postpartum (Nunes and Phipps, 2013).

Ten studies reported depression as a continuum of severity. Two studies included a dichotomous cut-off of participants either presenting with no depression or at least some depression (Figueiredo et al., 2007; Lanzi et al., 2009). However, the former study did not include subgroup analyses on adolescents (they combined the adolescent and adult participants in the multi-linear regression), therefore associations between risk factors and PPD symptoms cannot be reported in this review. The remaining study (Nunes and Phipps, 2013) categorised participants as having either no symptoms, mild, or moderate-severe PPD symptoms. Only one study (Silverman et al., 2017) used clinical diagnoses of PPD as their dependent variable. See Table 3.

Risk Factors

Variables measured or reported prior to birth were considered as potential risk factors for PPD. See Table 3. Between one and eight variables in each study were extracted, those that were reported in at least two or more studies are described below.

Prior Depression

The most measured risk factor, measured in seven studies, was prior depression (or symptom severity). Three studies reported a significant association between prior depression and PPD symptoms. Hipwell and colleagues (2016b) found that PPD symptoms significantly negatively correlated with prior depressive symptoms up to four years preceding childbirth (T-4 Depression ($r=0.18$, small Effect Size; ES), T-3 Depression ($r=0.25$, small ES), T-2 Depression ($r=0.32$, medium ES), T-1 Depression ($r=0.24$, small ES). Zeiders and colleagues (2015) also found a significant positive association ($r=0.53$, large ES) between prenatal depression and PPD symptoms. Nunes and Phipps (2013) found that having depression in the year prior to pregnancy increased the likelihood that adolescents would have moderate-severe PPD symptoms and this was a significant risk factor (OR=3.38, estimated small-medium ES) in the adolescent-specific predictive model. However, two studies did not find a significant association between prior depression and PPD (Hipwell et al., 2016a; Lanzi et al., 2009).

The final study (Silverman et al., 2017), only investigated whether prior depression had an impact on clinically-diagnosed PPD among adolescents as compared to adults aged 25-29. Unsurprisingly, only a small percentage of adolescents had a history of diagnosed depression, in comparison to the adult participants, and this appeared to confer a lesser risk for PPD as compared to the 25-29 year olds. In contrast, for adolescents without a history of depression (97% of the adolescent sample), there was a statistically significant increase in PPD risk in the 15-19 year olds, compared with the 25-29 year olds. This study did not report on the risk for PPD, taking into account history of depression, within the adolescent population itself.

Ethnicity and Age

Although ethnicity was measured as a risk factor in six studies, none found a statistically significant association with PPD symptoms. Five studies investigated age as a potential risk factor for PPD symptoms. All but one found a trend in the same direction suggesting that younger adolescent age incurred an increased likelihood for PPD symptoms. However, this association was only statistically significant in three studies (Kalil et al., 1998, $r=0.3$, medium ES; Spencer et

al., 2002, $r=-0.19$, small ES). The remaining study (Logsdon et al., 2008) found a marginally significant positive correlation between age and depressive symptoms (ES not calculable).

Socio-economic Variables

Grandmother education was reported as a risk factor in three studies. Two studies found no association with PPD symptoms (Kalil et al., 1998; Spencer et al., 2002) and one study (Secco et al., 2007) found that this variable accounted for 7% of the variance in depression ($r=0.21$, small ES).

Household poverty was measured as another socio-economic variable by Hipwell and colleagues (2016b), however they did not find significant associations between this measure and PPD symptoms. Zeiders and colleagues (2015) found that a measure of economic hardship significantly correlated ($r=0.20$, small ES) with PPD symptoms in the expected direction. Two studies measured adolescent's prior employment and education level in relation to PPD symptoms. One study (Figueiredo et al., 2007) did not report appropriate sub-group analyses for adolescents, the other study (Lanzi et al., 2009) did not find any significant associations.

Pregnancy Intention, Social Support and Perceived Competence

Both studies exploring the association between adolescent planned pregnancy prior to childbirth and PPD symptoms found no statistically significant association. Perceived family social support, but not friend social support, was found to be statistically significantly associated with PPD symptoms in two studies (Secco, 1997, $r=-0.33$, medium ES; Secco et al., 2007, $r=-0.31$, medium ES). Two studies reported on expected competence of infant care, however only Secco and colleagues (2007) found that more positive infant care emotionality was statistically significantly associated with lower PPD symptoms ($r=0.44$, medium ES).

Additional Risk Factors

Notably, 10 statistically significant associations were found between PPD symptoms and risk factors reported only once across studies. These included physical abuse ($d=0.54$, medium

ES), sexual abuse ($d=1.57$, large ES) (Gilson & Lancaster, 2008), anxiety up to three years prior to birth

(T-3 Anxiety: $r=0.16$, small ES; T-2 Anxiety: $r=0.27$ medium ES; T-1 Anxiety: $r=0.37$, medium ES), (Hipwell et al., 2016b), and grandmother acceptance during childhood ($r=-0.33$, medium ES) (Leadbeater & Linares, 1992). Further significant associations included multiple stressors (OR= 9.50, large ES), drinking alcohol or smoking prior to pregnancy (prior alcohol: OR 2.04, small ES; prior smoking: OR=2.01 small ES) or during the third trimester (alcohol: OR=2.95 small-medium ES; smoking: OR=2.06, small ES) (Nunes & Phipps, 2013), low self-esteem ($r=-0.43$, medium ES) (Secco, 1997), acculturative stress ($r=0.32$, medium ES) and enculturative stress ($r=0.22$, small ES) (Zeiders et al., 2015).

Discussion

This systematic review aimed to synthesise and appraise the quality of current evidence for adolescent PPD risk factors. In total, 14 studies met all eligibility criteria, representing 11 cohorts that were included in this review. Results highlighted several statistically significant risk factors for adolescent PPD found across more than one study, which included prior depression, lack of familial social support, and socio-economic hardship. Younger maternal age was also found to be significant across two studies, although these cohorts overlap. Thus, interpretation of younger maternal age as a risk factor may require further examination before firm conclusion can be drawn. The methodological quality varied from weak to strong across studies, however there did not appear to be a pattern regarding the effect sizes of risk factors when considering methodological quality.

Within this review, there was a lack of definitive support for any one risk factor across all studies. Nevertheless, the findings are somewhat in line with previous reviews within this topic area. However, compared with previous reviews, this review yielded fewer studies and fewer significant associations between risk factors and PPD. This is likely a result of the more stringent inclusion criteria used in this review. Furthermore, the quality appraisal of studies in this review

has also revealed discrepancies in methodological quality between studies exploring similar risk factors, which previous reviews have not highlighted.

Commonly Implicated Risk Factors of PPD in Adolescence

Prior depression was the most reported risk factor for adolescent PPD symptoms, statistically significant across three studies. Two studies, with weak and strong quality ratings, found significant associations (both small-medium effect sizes) between depression prior to pregnancy and PPD, yet the third study, which received a strong quality rating, found a significant association (with a large effect size) between prenatal depression and PPD. This might suggest that the closer the experience of depression to the birth of the child, the greater its predictive power for PPD. Noteworthy, two studies did not find prior depression to be a statistically significant risk factor for adolescent PPD. One possibility for this inconsistency in findings across studies, in relation to prior depression as a risk factor in adolescents, may be that adolescents have had less of an opportunity to experience depression prior to pregnancy. This hypothesis warrants further investigation, using comparisons between older adolescent and younger adolescent subgroups in future studies, before firm conclusions can be drawn.

Prior depression is a well-established risk factor for PPD within the adult literature (Robertson et al., 2004), however the mechanisms by which this influences the risk of PPD may be different among adolescents. The integrative framework of developmental psychopathology (Cicchetti & Toth, 2008), may offer some insight into the influence of prior depression on adolescent PPD. This theoretical framework emphasises the dynamic associations between a developing adolescent and their changing internal and external contexts (Sameroff, 2000). Adolescence marks extensive changes to biopsychosocial systems. If an adolescent is susceptible to a depressive disorder during this time, it is likely that the occurrence of pregnancy, birth, and motherhood (experiences also marked by profound biopsychosocial changes) during the same developmental time-period, will trigger a reoccurrence of depression. This idea is supported by the life course theory (Elder, 1998), whereby those that are vulnerable to developing depression during adolescence may also be at an increased risk of adolescent pregnancy through self-

selection effects. The notion that prior depression may put adolescents at risk of becoming adolescent parents in the first instance could account for the increased prevalence of PPD in this population (Corcoran and Jacqueline, 2016).

Perceived social support from the family was also found to be negatively associated with PPD symptoms (medium effect size), in two studies of moderate and strong quality, and could act as a protective factor against PPD. This may be due to family members being more attuned to the adolescent's triggers or mood fluctuations prior to, or during pregnancy. Indeed, family members may first recognise symptoms of depression in a new mother, and therefore initiate help-seeking and early intervention (Easterbrooks et al., 2016). Of interest, support from friends was not associated with PPD in these same studies. It has been suggested that perceived social support may be mediated by an adolescent's interpersonal skills, i.e., if an adolescent has poor interpersonal skills, their perceived and actual support from others may be reduced (Nilsen et al., 2013). Adolescents with interpersonal skills deficits may be at higher risk of becoming adolescent mothers in the first instance, and there is evidence of a higher prevalence of interpersonal difficulties in this population, as compared to non-childbearing adolescents (Hammen et al., 2011). This may result in fewer friendships for adolescent mothers and could explain why perceived friend support was not found to be significantly associated with PPD symptoms.

Lower scores on socio-economic measures were also significantly associated with higher depressive symptoms (with small effect sizes) in two studies (Secco et al., 2007; Zeiders et al., 2015). The fact that both these studies received a strong methodological quality rating gives credence to the implication that adolescent mothers who are more socio-economically deprived are more at risk for PPD. This is supported by previous research separately linking socio-economic deprivation to both adolescent depression (Sweeting and Hunt, 2014) and adolescent pregnancy (Penman-Aguilar et al., 2013). It is possible, however, that other factors interact with, or moderate the association between SES and PPD symptoms (Chen & Miller, 2013). Moreover, most studies measuring socio-economic risk factors found no significant associations with PPD, and there was a lack of consistency in definitions and measures of this construct across studies.

Such mixed findings parallel with previous reviews of adolescent PPD, suggesting that further research is warranted regarding socio-economic variables as a risk factor for adolescent PPD.

It is also important to note that several other significant associations between risk factors and PPD were found and warrant further study. Younger maternal age was significantly associated with higher PPD symptoms in two studies rated as having strong methodological quality in this review (small-medium effect size). This finding supports the theoretical stance of adolescent childbearing being an 'off-time transition' (Elder, 1998). For example, younger adolescent mothers may be especially vulnerable to the detrimental effects of social stigmatisation. Additionally, it is important to consider that the factors that confer risk for such an early pregnancy may equally put adolescents at risk of PPD. Within the developmental psychopathology perspective, younger adolescents may have reduced cognitive and emotional capacities to deal with motherhood, given the accompanying biopsychosocial changes. Moreover, different risk factors may predict earlier adolescent pregnancy/PPD compared to later adolescent pregnancy/PPD. Future PPD research should consider controlling for age or developmental variation within adolescent samples. Prior sexual and physical abuse are also risk factors that warrant further exploration within the context of wider literature, given the unique vulnerability of this population. For example, research has suggested that those who have experienced sexual and physical violence are more likely to become adolescent parents, and are over-represented in this population (Noll et al., 2009). Adolescent mothers with histories of sexual and physical abuse are also more likely to engage in risky behaviours such as substance misuse, which can negatively impact on both the mother and her child (Udo et al., 2016). Furthermore, adolescent self-esteem, anxiety, use of alcohol and/or tobacco consumption, as well as other stressors may be implicated in PPD onset within adolescent populations, and warrant further exploration considering the results of this review.

Implications of the Quality Assessment of Included Studies

The findings of this systematic review are dependent on the quality of the included studies. Most studies were appraised as having strong methodological quality, giving credibility to the results and conclusions drawn from these studies. Moreover, the timing of risk factors within

studies was reported and/or measured prior to the postpartum period, giving greater credence to their ability to be antecedent risk factors. Nevertheless, several methodological limitations must be noted.

Importantly, the measurement tools and definitions of PPD differed across studies. The varied utilisation of measurement tools of PPD may have resulted in different operationalisations of PPD among studies (Offord and Kraemer, 2000). Within analyses, coding strategies also differed across studies (e.g., binary, continuous) and studies used differing cut-off thresholds for depressive symptomology, which may also affect interpretation of results. Furthermore, one study (Nunes and Phipps, 2013) did not mention validation of their PPD measure, which may limit the validity of their findings (Birkeland et al., 2005). Importantly, some measures may not be appropriate for assessment of adolescent PPD. For example, Gaynes et al., (2005) suggested the BDI has lower sensitivity than other PPD measures and previous research suggests that the EPDS may be the most clinically useful measure for adolescent PPD screening (Logsdon & Myers, 2010). Further discrepancies between studies include the varied timing of PPD measurement (from three weeks to 10 months postpartum). For example, only five studies within this review adhered to the time-specific PPD measurement criterion as specified by the diagnostic manuals, (i.e., onset up to four or six weeks postpartum for the DSM 5 and ICD-10, respectively; APA, 2013). It may be that PPD has stronger associations with risk factors over shorter follow-up periods, or that studies measuring depression several months postpartum are measuring depression that is conceptually different to PPD. Risk factor research necessitates that the outcome of interest (i.e., PPD) be clearly and reliably defined (Kraemer et al., 1997). Consequently, the above measurement discrepancies restricted comparability across studies.

With regards to ascertaining risk factors for clinically diagnosed PPD, it is notable that only one study in this review was conducted with a clinical sample. All other studies measured self-reported depression symptom severity, and although four studies stated whether participants had clinically significant symptoms, most studies can only be described to have investigated factors predictive of a sub-clinical range of functioning, thus limiting the generalisability of the findings

from these studies (Waters, 2008). Finally, none of the studies reported an a priori power calculation, and consequently some studies that did not find significant associations may have been underpowered.

Clinical Practice and Future Research

The findings from this review may have implications for clinical practice and policy. Healthcare professionals could benefit from establishing whether pregnant adolescents have a history of depressive illness, what familial social support they have access to, and their socioeconomic status, as these factors may influence how the adolescent copes with the perinatal period. Screening tools would offer healthcare professionals additional information for assessment of both risk factors and PPD among adolescents. In this context, it would be beneficial for all pregnant adolescents to be screened during their routine prenatal visits, although practical implementation would require screening tools that are short and feasible to administer within these visits. Such routine screening may enable earlier signposting of resources or services, which may aid in decreasing an adolescent's risk of PPD.

Future research would be well placed to focus on the antecedent risk factors for PPD, which are specific to the adolescent population. This review yielded only 14 studies assessing risk factors, half of which set out to specifically identify risk factors of adolescent PPD. Thus, additional studies are needed, which use consistent and timely measures of PPD, to ensure studies are measuring the same construct within the most vulnerable time frame and adhering to the diagnostic conceptualisation of PPD. Longitudinal prospective data afford the best way to establish time-ordering of variables. Thus, more longitudinal studies of PPD risk factors are required, ideally among clinical samples (i.e., with formal PPD diagnoses), using validated measures of PPD with adolescent populations (e.g. the EPDS). Prospective studies of nulliparous adolescents at risk of adolescent pregnancy would enable the assessment of adolescents who go on to become pregnant and potentially develop PPD. Within this design, researchers could ascertain adolescents who may be at high risk for PPD, but do not go on to develop it, potentially highlighting protective

factors. Such protective factors may be important to promote in high-risk adolescents generally (Cicchetti & Rogosch, 2002).

In line with STROBE recommendations (Vandenbroucke et al., 2007), future studies would also benefit from reporting effect sizes, and conducting and reporting an a priori power analysis, to ensure adequately powered research. If future studies utilise more homogenous designs, measures, follow-up periods, and populations, as well as clearly-defined risk factors and PPD definitions, this would allow for greater comparison across groups.

Strengths and Limitations

Despite inherent strengths of this systematic review (e.g., the use of a comprehensive search strategy, stringent eligibility criteria, and the use of two independent reviewers to screen initial articles and rate methodological bias of included articles), several limitations of the review process must be addressed. Due to the lack of knowledge of multiple languages, it was not possible to include studies written in languages other than English. Relevant studies may have been missed due to this criterion, therefore future research may wish to include studies written in other languages.

Additionally, the selection following full text review and the risk of bias of studies was conducted primarily by the first author, with only a subsample being cross-checked against the eligibility criteria by the second author and an independent reviewer. This may have led to some potential bias in the selection of studies (Boland et al., 2014), despite 100% of the initial screening being done in duplication. Moreover, during the initial quality appraisal of included studies, the ratings for selection bias achieved only 'slight agreement' between raters. This low agreement indicates that there was ambiguity with regards to the interpretation of some of the included studies' participant selection procedures. This limitation should be considered when appraising the generalisability of included studies, and their respective results. Furthermore, studies which may have used overlapping participant data were reported separately, due to the differences in risk factors, outcome measures, and follow-up periods used. Nevertheless, this may have multiplied, and subsequently over-estimated any significant findings from these studies (Burgess et al., 2016).

Conclusion

The identification of risk factors for PPD development in adolescent mothers is crucial given the negative outcomes for both mother and child. This systematic review highlighted several factors that may be implicated in the onset of adolescent PPD including prior depression, lack of familial social support and socio-economic hardship. However, these findings must be considered with caution given the heterogeneity of outcome measures, and timing of assessments used across studies. To the best of our knowledge, this is the first systematic review examining antecedent PPD risk factors, utilising longitudinal designs or retrospective report. Future research aiming to better understand risk factors for adolescent PPD should consider employing prospective longitudinal designs, as well as clearly-defined, timely, and validated measurements of risk factors and PPD. Such research may significantly benefit healthcare practitioners who engage with this vulnerable population, particularly when developing preventative programmes for adolescents at risk of PPD.

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